THE NEED OF ANTHROPOMETRY

AND

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40 CLIFTON PLACE, BROOKLYN, N.Y.

The Need of Anthropometry,

A PAPER

Read by Dr. Edward E. Hitchcock, President of the American Association for the Advancement of Physical Education, at its Second Annual Meeting in Brooklyn, N.Y., November Twenty-sixth, Eighteen Hundred and Eighty-six.

ALSO, THE REPORT

of the

COMMITTEE UPON THE METHOD OF PHYSICAL MEASUREMENT,

consisting of

Dr. D. A. Sargent, Dr. Edw. Hitchcock, and Dr. Wm. G. Anderson.

made at the same meeting.

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Dr. S. A. Green

ANTHROPOMETRY.

"If we are to devote our attention, before all things, to what can be measured or weighed, the living man is the first object which demands our investigation."—*Carl Vogt.*

THE study of Anthropometry, or the proportions of the human body, is not modern, but reaches back to the remote civilization of India, when we find a treatise called Silpi Sastri, which investigated the outline of the body by dividing it into 480 parts.

In later times the Greeks proposed a "Canon" or model in the shape of a statue called Doryphoros, which was claimed to be the pattern for the human figure.

Still later the mathematical law was applied to the human body, an entirely artificial system; hence we obtain the terms cubit, hand-breadth, ell and so on.

An Italian sculptor, Alberti, proposed a module of one foot in height, which was divided into ten degrees and minutes, as a standard for the proportions of the human body.

In 1854 a German, Carus, proposed an anatomical basis for determining human bodily proportions, assuming the hand length for the unit, and the adult vertebral column of 24 free vertebræ, to be the key to these proportions.

But the father of Anthropometry is Baron Quetelet of Belgium, who, in the middle part of the present century, offered the actual measurements of the body and the means and averages deduced from them as the true and scientific way of ascertaining human proportions; adopting the Baconian method of reasoning from the effect to the cause, from the concrete to the abstract.

Of course in the Divine mind there is the ideal or plan not only of the great groups of animals but of man also. And this idea is not given to us as complete and clear as the human architect furnishes the plans and specifications of the house he will build. We are left to study and work out what this plan may be. There is thus furnished to us the joy and stimulus of new discovery, and the impulse of advanced knowledge.

Without doubt all of us have heard of one or more so called systems of Physical Culture. This means that some quite intelligent man or woman has accidentally or purposely been led to study the value of a way of giving better bodily development and strength to a few or many people. This method or system regards muscular movements, food matters, a care of the skin, and perhaps the lungs. Some more or less simple exercises, in perhaps a peculiar way, having special regard to air, light, food or surroundings, have seemed to accomplish so much that an institute is set up somewhere and a "system" is let loose upon the world. And it matters not that some other person equally intelligent and well disposed seems to discover another system quite differing in practice and principle.

Could we get an enumeration of these systems, perhaps we should find them by the hundred, and most of them would be able to show actual good accomplished, since they make use of a few substantial principles of sound physical education, together with some empirical knowledge and facts which were properly applied to the persons making use of them.

But it seems safe to say that the artisans of these systems gain their success by information shrewdly gained in the daily school of experience and common sense, rather than from the acquisition and application of sound principles and data as furnished by anatomy, physiology and the laws of health.

It is not too much to claim that no reliable and valuable work for physical health and development can be done without a good understanding of how the body is made up, what its normal proportions are, what it can do in peril or emergencies, and what it is expected to do in the ordinary course of life. Hence the man or woman who is to be a leader or teacher in physical education must have not only general but a special knowledge of our material body which is to be instructed and developed up to its normal powers. Perhaps it is too much to say that every teacher in our line should be an educated physician. But a thorough acquaintance with the structure of the body, of just what it is all made, and how put together ; a knowledge of what the whole body and each part can do ; of the theory of many of the vital processes ; of the ordinary and extraordinary powers of men and women in different ages and among different races ; of the controlling influence of temperament, educational and religious ideas on the physical man ; and lastly, all possible information how to keep

this glorious body of ours up to the highest and at the same time safe working power, is the information and training which should be possessed by him or her to whom is entrusted the physical training of our youth. Such ought to be the outfit of any one who may hope to receive the approval of this our young but honorable association.

Thus, then, we come directly to the needs of Anthropometry in our profession. We want a basis, a type, or an ideal which we can work from. By means of our anatomy we learn the shape and relation of the parts of the body; by our physiology what these parts can be expected to do. But human beings are of different sizes, weights, heights and powers the world over; not only are there race peculiarities, but there are individual limits with considerable differentiation in each race.

As a rule we expect the person of the largest frame to be the strongest, and in so far as he makes use of his limbs as levers it is true. But we all know that the power to endure climatic irregularities, the ability to resist disease, the fortitude and courage to bear the great burdens of life, do not always come to him who has the most bone and muscle. And so there is this fact to be considered right here, that while there is this ideal man—who to be sure is yet somewhat up in the air—whose measures and tests are definite, there is a scale, or a curve, or a table of figures and words, which will give us the features and proportions of these variations whether they are apparent in form, weight, age or height. All have not the averages of the typical man, and yet what shall be the law or model of the abilities and development of those who vary from this standard. This is what our anthropometric work will attempt to do. We ascertain the pedigee. Did parents and grandparents live to an old age? did hereditary affections carry off uncles, aunts, sisters, brothers or cousins? what, if any, disease has already made its mark on the individual? have injury or accident crippled bone or muscle, and left their traces in other organs? is the heart a good and sound pump to send the blood through its vessels? are the lungs of suitable capacity and with able muscles to inflate them? are both eyes alike? are they symmetrical, giving a correct image, or must the brain and intellect suffer in attempting to correct these imperfections? are the ears alike, or must bodily and mental movements be imperfect and uncertain because the little organ of hearing is imperfect?

But why the need of the many bodily measurements and tests,

the length and size of bones, and the girth of body and extremities, and the power to contract the muscles?

The ultimate and philosophical aim of Anthropometry is to ascertain the ideal or typical man, and this must be the result obtained before we can do our best work. But this practical age, the authority of boards of trustees, and the anxiety of fond parents, and the direct needs of physical culture, compel us not only to aim at the transcendental, but to give advice as to the physical condition of our young people who are not typical or ideal. We want to be able to tell normally developed people what deficiencies they have, if any, and how their best development can be brought about. And what shall be the character or standard we use in this work—shall it be age, weight, height or some other basis?

We cannot use age as the standard, since so many different weights, sizes, and powers are found at the same age, and what might be adapted for the person of 25 would be inadequate for the youth of 15. So also weight will be found wanting as a standard for these determinations, and for similar reasons.

And so will *any characteristics if in our present state of anthropometric knowledge we assume an absolute or perfect standard.* But the height of the individual, as seen by the rules of common sense, seems to have a stronger claim for a basis of proper proportions than can any other principle, so far as now understood. And the law of beauty confirms this view, since for the longer perpendicular lines of the body there must be larger corresponding girths in order to give the proper and graceful curves of trunk and limbs than for the shorter ones. The physiological fact has long ago been settled that lung capacity has a fixed ratio to bodily height, and military men well know that the soldier whose chest and abdomen (or sitting height) are the longest in proportion to the legs, will have greater physical endurance than the reverse.

An advanced idea in anthropometrics, then, may be to furnish a series of charts or tables of different heights, say a centimeter or half inch apart, by which any person may see at a glance whether he corresponds or not in certain bodily measurements and tests to the averages which these charts represent.

Amherst College for several years past has been gathering an accurate series of these measurements—about 60 from each student—from which have been constructed charts or tables for 25 different heights varing from 5 to 6 feet. These have been made from

the records of about 1000 students. Each student on entering is at once examined by the physicians of the college and his record placed by the side of the averages of his own height, and he of course can make a numerical comparison for himself.

But he is not left here alone. Before his card is placed in his own hands, the physician carefully studies the record, the heredity, as well as any other circumstances and even probabilities which may affect his condition, and in many instances he (the physician) gives advice written, verbal or printed, which he thinks may be of service to him. In other words, a prescription or printed circular, like patent medicine, is not merely pushed into his hands and he told to go on his way, but the one needing help is personally advised and looked after. The measures, tests and knowledge of external conditions and powers are all very well, but they must be supplemented by a personal knowledge of the young man, and perhaps by suggestions offered to him. Tape, rod, stethoscope and dynamometer cannot tell all about latent weakness and disease, or even, much more important, vital strength. The temperament, the bearing, the address, the habits and the "*tout ensemble*" of the man will greatly guide the wise and careful anthropometrist, who will essentially regard the measurements as the nucleus around which must be gathered the material of the whole physical man. He needs nursing as well as medical or surgical treatment.

The use of the measurements and tests as here alluded to is to give a start or aid to the teacher of youth, and to afford him a tangible and numerical basis by which he can begin to lead and guide the young man, woman or child in a way to preserve and promote their health. And yet let no teacher be so zealous or daring as to say that he has a correct and unalterable table of data as yet compiled, so that he can talk with certainty about exact proportions of the human body. Rather let him direct and advise with much caution, since the day of rational Anthropometry is but just begun. Our data are only units thus far ; we have not got to the tens as yet ; many years will be necessary to reach the hundreds.

Hence, let every one who takes these measures first take them *intelligently* ; find out just how they are secured so that they may be compared with the work of others, and thus add to the sum total of results. Then let them be taken *accurately*. Somebody has said that you can prove anything by your statistics if you only set out with and keep that in mind from the first. So don't wish

to prove that your pupils grow faster or have bigger and broader measures than some other school has. Rather make every measure exact, as if the only thing was to secure the item at that moment on the tape, and then the whole thing were done. You and I may not live to see the results. Leave that to those who are coming. But let us do our work as if fully in love with it, and for the improvement of those for whom we labor and for all mankind. And then, perhaps after all we shall be glad to say with the poet:

> "Our little systems have their day;
> They have their day and then they cease to be.
> They are but broken lights of thee,
> And thou, O Lord, art more than all."

Report of the Committee on Statistics, appointed by the Association in 1885, *giving the detailed method of securing measurements, tests, and the condition of the human body.*

ANTHROPOMETRIC MEASUREMENTS.

NUMBER.—In order to secure privacy the individual should be entered in the record book by number. As a means of identification the number can be entered in an alphabetical index book opposite the corresponding name, as:

Smith, John H., 526.

For further convenience it is advisable to enter the name in a numerical index book opposite the corresponding number, as:

526, John H. Smith.

DATE.—Record the year, month, day and hour, as: Jan., '86, 12, 9 A.M. Where perfect accuracy is desired, note should be made of the time that has elapsed since eating, the occupation of previous hours, and of the temperature of the room.

AGE.—Record years and months, as: 21, 9, *i.e.*, twenty-one years and nine months.

WEIGHT.—The weight of the body should be taken without clothes. Where this is impracticable the weight of the clothes should be deducted.

HEIGHT.—The height should be taken without shoes and with the head uncovered. The head and figure should be held easily erect, and the heels together. This position is best secured by bringing the heels, the buttocks, the spine between the shoulders and the back of the head, in contact with the measuring rod.

HEIGHT OF KNEE.—The subject should place one foot on a box

or chair of such a height that the knee is bent at a right angle. A box about 12 in. high is suitable for adults. Press a ruler upwards with a force of about one pound against the ham string tendons close to the calf of the leg. See that the ruler is held in a position at right angles to the vertical rod, and measure the height of the top of the ruler from the box.

HEIGHT SITTING.—Let the subject sit on a hard, flat surface about 12 inches high, such as afforded by a box or chair, with the head and figure easily erect so that the measuring rod will touch the body at the buttocks, between the shoulders, and at the back of the head. Measure the distance from the box to the vertex.

HEIGHT OF PUBES.—With the subject standing easily erect on the box or floor, measure up to the lower edge of the pubic bone.

HEIGHT OF CROTCH.—With the subject standing easily erect on the box or floor facing the vertical rod, press a ruler firmly against the perineum (crotch) and measure the height of the top of the ruler.

HEIGHT OF NAVEL.—With the figure and head of the subject erect, measure the height of the centre of the cicatrix.

HEIGHT OF STERNUM.—With the figure and head of the subject erect, measure the height of the interclavicular notch.

GIRTH OF HEAD.—This measurement should be taken around the head with the tape at the upper edge of the eye brows, over the supra orbital and occipital prominences. All girths should be made on the skin itself and at right angles to the axis of the body or limb at the point of measurement. No oblique measurements are taken.

GIRTH OF NECK.—With the head of the subject erect, pass the tape around the neck half way between the head and body, or just below the "Adam's apple."

GIRTH OF CHEST.—Pass the tape around the chest so that it shall embrace the scapulæ and cover the nipple. The arms of the subject should be held in a horizontal position while the tape is being adjusted and then allowed to hang naturally at the sides. Take the girth here before and after inflation.

Where it is desirable to test the elasticity or extreme mobility of the walls of the chest, a third measurement may be taken after the air has been forced out and the chest contracted to its greatest extent. To test the respiratory power, independent of muscular development, pass the tape around the body below the pectora line and the inferior angles of the scapulæ, so that the upper edge shall be two inches below the nipples. Take the girth here before and after inflation.

GIRTH OF WAIST.—The waist should be measured at the smallest part after a natural expiration.

GIRTH OF HIPS.—The subject should stand erect with feet together. Pass the tape around the hips above the pubes over the trochanters and the glutei muscles.

GIRTH OF THIGHS.—With the feet of the subject about six inches apart, the muscles set just enough to sustain the equilibrium of the body and the weight distributed equally to each leg in gluteal fold, measure around the thigh just below the nates.

GIRTH OF KNEE.—With the knee of the subject straight and the weight of the body equally supported on both legs, measure over the centre of the patella.

GIRTH OF CALF.—With the heels down and the weight of the body supported equally on both feet, the tape should be placed around the largest part of the calf.

GIRTH OF INSTEP.—Measure around the instep at right angles with the top of the foot, passing a point at the bottom of the foot midway between the end of the great toe and back of the heel.

GIRTH OF UPPER ARM.— With the arm of subject bent hard at elbow, firmly contracting the biceps and held away from the body in a horizontal position, pass the tape around the greatest prominence. If desirable to find the girth of the upper arm when the biceps is not contracted, the arm should be held in a horizontal position and measured around the most prominent part.

GIRTH OF ELBOW.—Taken around the internal condyle of the humerus while the arm of the subject is straight, with the muscles of the forearm relaxed.

GIRTH OF FOREARM.—Taken around the largest part. The fist should be firmly clinched and the palm of the hand turned upward.

GIRTH OF WRIST.—With the hands of the subject open and the muscles of the forearm relaxed, measure between the styloid process and the hand.

BREADTH OF HEAD.—The breadth of head should be taken at the broadest part. In taking the breadth measurements, stand behind the subject.

BREADTH OF NECK.—Taken at the narrowest part with the head of the subject erect and the muscles of the neck relaxed.

BREADTH OF SHOULDERS.—With the subject standing in a natural position, elbows at the sides, shoulders neither dropped forward nor braced backward, measure the broadest part two inches below the acromion processes.

Breadth of Waist.—Taken at the narrowest part.

Breadth of Hips.—Measure the widest part over the trochanters, while the subject stands with feet together, the weight resting equally on both legs.

Breadth of Nipples.—Taken from centre to centre with the chest in a natural position.

Depth of Chest.—Taken after a natural inspiration. Place one foot of the calipers on the sternum midway between the nipples, and the other foot on the spine at such a point that the line of measurement is at right angles with the axis of the spinal column. When it is desirable to ascertain the extent of the antero-posterior movement of the chest, measurements may be taken from the same points after the fullest inspiration and after the fullest expiration.

Depth of Abdomen.—Place one foot of the calipers immediately above the navel, the other on the spine at such a point that the line of measurement is at right angles to the axis of the spinal column.

Length of Shoulder to Elbow.—With the arm of the subject bent sharply at the elbow and held at the side, measure from the top of the acromion process to the olecranon. Care should be taken that the measuring rod is parallel with the humerus and not with the external surface of the arm.

Length from Elbow to Finger Tip.—With the arm of the subject bent sharply at the elbow and the rod resting on back of arm and hand, measure from the olecranon process to the tip of the middle finger.

Length of Foot.—Take the extreme length of foot from the end of the first or second toe to the back of the heel, about one inch from the surface upon which the foot rests.

Stretch of Arms.—With the arms of subject stretched out horizontally so that both hands and shoulders are in a line, with one middle finger and the zero end of the measuring rod pressed against the wall, note the point to which the other middle finger tip reaches.

Horizontal Length.—With the heels of the subject pressed hard against a perpendicular wall, with arms at the sides and body resting naturally on a horizontal plane, measure the distance of the apex of the head from the wall.

Capacity of Lungs.—The subject after loosening the clothing about the chest and taking a full inspiration, filling the lungs to their utmost capacity, should blow slowly into the spirometer. Two or three trials may be allowed.

EXPIRATORY STRENGTH.—As before, the subject after loosening the clothing about the chest and filling the lungs completely, should blow with one blast into the manometer. Care should be taken that no air is allowed to escape at the sides of the mouth, and that in expelling the air all the muscles of expiration are brought into play.

STRENGTH OF BACK.—The subject, standing upon the iron foot-rest with the dynometer so arranged that when grasping the handles with both hands his body will be inclined forward at an angle of 60°, should take a full breath and, without bending the knees, give one hard lift, mostly with the back.

STRENGTH OF LEGS.—The subject while standing on the foot-rest with body and head erect, and chest thrown forward, should sink down, by bending the knees, until the handle grasped rests against the thighs, then taking a full breath, he should lift hard principally with the legs, using the hands to hold the handle in place.

STRENGTH OF CHEST.—The subject with his elbows extended at the sides until the forearms are on the same horizontal plane and holding the dynometer so that the dial will face outward and the indicator point upward, should take a full breath and push vigorously against the handles, allowing the back of the instrument to press on the chest.

STRENGTH OF UPPER ARMS, TRICEPS.—The subject, while holding the position of rest upon the parallel bars, supporting his weight with arms straight, should let the body down until the chin is level with the bars, and then push it up again until the arms are fully extended. Note the number of times that he can lift himself in this manner.

STRENGTH OF UPPER ARMS, BICEPS.—The subject should grasp a horizontal bar or pair of rings and hang with the feet clear from the floor while the arms are extended. Note the number of times that he can haul his body up until his chin touches the bar or ring.

STRENGTH OF FOREARMS.—The subject, while holding the dynamometer so that the dial is turned inward, should squeeze the spring as hard as possible, first with the right hand then with the left. The strength of the muscles between the shoulders may be tested with the same instrument. The subject, while holding the dynamometer on a level with the chest, should grasp it with handles and pull with both arms from the centre outward.

PILOSITY.—Note the amount of hair on the body and limbs, excluding the head, face and pubes.

COLOR OF HAIR.—*Light* (Very Fair, Fair, Light Brown, Brown), *Dark* (Dark Brown, Black Brown, Black). *Red* (Red Brown, Red, Golden).

COLOR OF EYES.—*Light* (Dark Blue, Blue, Light Blue). *Dark* (Light Brown, Brown, Dark Brown, Black). *Mixed* (Gray, Green).

D. A. SARGENT,
EDW HITCHCOCK,
WM. G. ANDERSON,
} *Committee.*

DIRECTIONS FOR TESTING THE REFRACTIVE CONDITION OF THE EYE.

Procure of any optician two pairs of spectacles, one with convex glasses, No.+.75 Dioptric (equal to No.+.48 in the old or English system), and the other with concave glasses, No.+.75 Dioptric. Also obtain a copy of Monoyer's test letters (a card of Dr. Dennett's modification of Monoyer's test type may be procured of Meyrowitz Bros., opticians, 295 and 297 Fourth Ave., New York City), to be hung up at 5 meters distance, and a copy of Green's astigmatic lines, in the form of a clock face, to be hung up at the same distance.

Test:—Seat the subject at a distance of five meters from the test cards, which should be hung in a good light. Examine each eye separately, keeping the other covered by a card or small book held in front of, but not touching it. Never press the fingers against the closed lid.

There are ten lines of letters on the test card, numbered from .1, .2, .3, etc., up to ten 10ths or 1. If now the subject can read the top line, the smallest letters on the card, with the right eye (R.E.) alone, his vision (V.) is recorded as ten 10ths or 1. (V.R.E. =1). If he sees nothing clearly above the fifth line from the bottom, but can read that correctly, then V.R E.=5. If he cannot read any of the lines, then V.R E.=0. (*i.e.*, less than one-10th). Whatever the vision without glasses may prove to be, *always next* put on the *convex* spectacles and again cover the other eye. If now he can still with the right eye see as well or better than with no glasses at all, and can read the same line as before,

he is Hypermetropic (H.) in that eye. For example, if without glasses it was found that V.R.E.=.5, and now after adding the convex glass his V. is improved to .8, the record would be V.R.E. =.5,+H.=.8. But if the vision is neither improved nor made worse by the convex glass, the record will be thus : V.R.E.=.5,+ H.=.5. If the convex glass can be used at all without decreasing the vision, no further testing with this card is needed ; the subject is hypermetropic in that eye.

If it is found that the vision of the right eye equals 1. without glasses, and then the addition of the convex glasses blurs the letters, the eye is Emmetropic, that is, the vision is normal (V.R.E. =1.).

If, however, the vision without glasses is less than 1., for instance only .3, and the convex glasses make even that line more indistinct, then put on the *concave* glasses. If now the vision is improved so that a higher line can be read, for instance the eighth from the bottom, the eye is Myopic, or " near sighted," and the record will be V.R.E =.3,+My.=.8. Or again, if the vision without glasses in the left eye is found to be .7 and then with the concave glass the top line can be read, the record will stand thus : V.R.E.=.7,+ My.= 1. After testing each eye separately, place the record of one above the other, for example thus : { V.R.E.=1. / V.L E.=.6,+My.=.9.

This completes the testing for simple hypermetropia, myopia and emmetropia.

After testing the eyes as above, if the vision has not yet been made perfect in either, leave on the proper correcting glass, the convex if there is hypermetropia, or the concave if there is myopia, or use no glass if there is neither; then direct the subject's attention with that eye alone, the other being covered, to the card of radiating black lines. If he sees one or more of the lines running in any direction clearer or blacker than those at right angles to them, he is shown to be astigmatic. Either the perpendicular or the horizontal lines usually appear the blacker to the astigmatic person. If the previous record was V.R.E.=.7 and this defect is found, then it will be V.R.E =.7,+As. Or if before it read : V.L.E.=.3,+My.=.6. and astigmatism is found, it will read, V.L.E.=.3,+My.=.6,+As. Astigmatism may exist either alone or in combination with My. or H. If alone we might have a record thus : V.R.E =.6,+As. ; V.L.E =.4,+As., or if with hypermetropia thus : V.R.E.=.7,+H.=.7,+As.; V.L.E.=.6,+H.=.8,+As.

To recapitulate, in brief : if it is found that V.R.E.=1, then the

R.E. is either Emmetropic or Hypermetropic. If emmetropic, the convex glass will markedly impair the vision; if hypermetropic it will not. If the V.R.E.=.9 or less, then the R.E. is either hypermetropic, myopic, astigmatic or amblyopic.

1*st.* If it is H. the convex glass will not greatly impair the vision.

2*nd.* If it is My. the concave glass will improve V.

3*rd.* If it is As. one of the radiating lines is blackest.

4*th.* If neither of these defects exists and the V. is less than .7 then Amblyopia or partial blindness may be recorded. It may read thus: V.L.E =.6, + Am.

Caution.—Always try the *convex* glass. *Never* try the *concave* unless the convex glass blurs the vision.

In the following cases the subject should be recommended to consult an oculist concerning the advisability of wearing glasses: If the vision without any glasses is less than .4 in either or both eyes; if he complains of weak, watery or painful eyes, especially in reading, and any degree of hypermetropia or astigmatism is found to exist.

Directions for Testing the Color Sense.

A reliable set of test worsteds of different colors may be procured for $1.25 of N. D. Whitney, 129 Tremont St., Boston. Among these will be found three large test skeins colored light green, purple (pink or rose), and bright red. To make the examination, spread all the worsteds out on a white cloth placed upon a table. First lay the *green* test skein a little to one side of the others, and then tell the subject to throw out of the pile and lay along side of the test skein all the lighter and darker shades of that color, or all the skeins containing a shade of that color in any degree. Avoid naming the color "green" to him. If he throws out only shades of green or light blues his color sense is normal (C.S.N.) and the test is completed. But if in addition he throws out light grays, or any other shade of gray, or light yellows, salmons, or pinks, he is color-blind. If he handles or fumbles over those shades a good deal and hesitates, as if in doubt about them, but yet does not throw them out, he probably has "feeble color sense" (C.S F.). The examiner in these cases must use his judgment in making a certain amount of allowance for the stupidity of some persons in understanding what is wanted, especially in the young and uneducated.

If the subject is found to be color-blind, next lay down the

purple or rose-colored test skein, in place of the green, in order to determine the nature of the defect. Now tell him to throw out all the different shades of that color. If he only throws out pinks and light reds and shades approaching these he is only partly color-blind. (P.C.B.) But if he throws out decidedly bluish, purples, blues, violets, greens, or grays, he is completely color-blind. (C.C.B.) Completely red blind if he throws out the blues, violets, etc., or green blind if the grays or greens.

No further testing is needed, but as a matter of curiosity and to prove the result, the red test skein may next be tried in the same way. If he matches with it browns or greens and grays he is completely color-blind. Dark brown or green if red blind, and light brown or green if green blind.

It is not important to record whether the complete color-blindness is red or green blindness. The following classes may be recorded :—Color sense normal=C.S.N. ; Color sense feeble= C.S.F. ; Partial color-blindness=P.C.B. ; Complete color-blindness =C.C.B.

Color-blind individuals should be warned against engaging in any occupation where this defect would prove dangerous or inconvenient.

Directions for Testing the Condition of the Ears.

Use an ordinary watch and a tuning fork, letter A. or C., as tests. Seat the subject with his right side toward you, and then while the room is perfectly quiet, see how far off he can hear the watch tick. Having previously learned by a few experiments what is the furthest distance at which the tick can be heard by normal ears, make that number of inches the denominator of a fraction, and the hearing distance of each person examined thereafter the numerator. Having found the normal distance (=H.D.) to be, for instance, about sixty inches, and that of the subject now examined to be, say forty inches, his record for the right ear would then be : H.D.R.E.=$\frac{40}{60}$. If it had been $\frac{60}{60}$ or 1, the ear would be normal. $\frac{80}{60}$ would show an abnormally acute sense of hearing. If the watch could only be heard while in *contact* with his ear, it would be recorded : H.D.R.E.=$\frac{0}{60}$. If not heard at all, then H.D.R.E.=$\frac{0}{60}$. Next test the left ear in the same way. Voice sounds in talking will often be easily heard by persons quite deaf to the watch tick, so the latter is not always a reliable practical test.

Suppose we have found H.D.R.E.=$\frac{40}{60}$, H.D.L.E.=1, this implies some deafness in the right ear, and the tuning fork will now help us to decide whether the cause lies in some defect of the auditory nerve or internal ear, or in the external or middle ear or Eustachian tube. Strike the fork against some solid substance, and then place the end of the handle against or between the subject's front teeth. If both ears are normal he will probably seem to hear the ringing of the fork equally well in both ears. But if there is a defect in one ear he will either seem to hear it louder or more feebly in the affected ear. If, as in the case we are examining, the fork is heard best in the deaf ear, this tells us that the deafness is due to some defect in the more external parts of the organ, and it can probably be corrected by appropriate treatment. But if it is heard best in the good ear, it goes to prove that the defect in the other ear is more deeply seated and cannot probably be greatly benefited by treatment. This effect of the tuning fork is contrary to what would ordinarily be expected, and it is often a matter of surprise to a deaf person to find that he hears with his teeth apparently better on the deaf side.

We may now add to our record in this case: T.F. best R.E. If it had been heard equally well in both ears we would record: T.F.=N. (or normal). Where the defect in hearing is at all marked a specialist in ear diseases should be consulted.

Our record in a normal case might be thus: H.D.R.E.=1, H.D.L.E.=1., T.F.=N.; or in an abnormal case it might be thus: H.D.R.E.=1., H.D.L.E.=$\frac{0}{60}$, T.F. best in R.E. This would imply that the subject was so deaf in the left ear as not to be able to hear the watch tick at all, and the fork held between the teeth could be heard best in the good ear, consequently his trouble is probably seated in the deeper structures of the ear, or in the nerve itself, and treatment would not be expected to help him greatly. The tuning fork need not be tried unless the watch tick shows some defect in hearing.